



“Assessment of Ambient Air Quality Status by using GIS Technology.”

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ABSTRACT

Air pollution is one of the major environmental issues and it can cause adverse health effects such as cancer, cardiovascular diseases and high mortality rates. High population density is a huge contributory factor of air pollution in cities and in urbanized areas. The main air pollutants of concern are suspended particles SO_2 , NO_2 , CO_2 , CO and poly aromatic hydrocarbons. Out of total polluted cities of the world 22 out of 30 were in India. This Paper mainly deals with the difference between the pollution level of Urban Air Quality of year 2013 and 2018 of the same area of the Amravati city. Air pollution contributes to the premature deaths of 2 million Indians every year. This study with the help of GIS (Geographical Information System) by using IDW (Inverse Distance Weightage).

Keywords: Geographical Information System (GIS) , Urban air quality , Sulphur dioxide SO_2 ,Nitrogen dioxide NO_2 , Carbon dioxide CO_2 , Carbon monoxide CO

INTRODUCTION

Ambient air quality monitoring programme are needed to determine the existing quality of air, evaluation of the effectiveness of control programme and to develop new programme, ambient air quality monitoring is carried out so as to generate data that meets the objectives of monitoring. For designing an ambient air quality monitoring network following aspects are considered

- Which pollutants should be monitored
- Location where monitoring should be carried out and
- Frequency of monitoring
- Duration of sampling
- The techniques to be used for sampling and analysis
- Infrastructural facilities
- Man power
- Operation and maintenance, etc.

The network design also depends upon the type of pollutants in the atmosphere through various common sources, called common urban air pollutants, such as Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulfur dioxide (SO_2), Oxides of Nitrogen (NO_2), and Carbon Monoxide (CO) etc. The areas to be chosen primarily are such areas which represent high traffic density, industrial growth, human population and its distribution, emission source, public complaints if any and the land use pattern etc. Generally, most of the time the basis of a network design are the pollution source and the pollutants presents.

Pollution	Annual Mean Concentration Range (ug/m ³)				
Level	Industrial (I)			Residential (R)	
	SO ₂ & NO _x	RSPM	SPM	SO ₂ , NO _x & RSPM	SPM
Low (L)	0-40	0-60	0-180	0-30	0-70
Moderate (M)	41-80	61-120	181-360	31-60	71-140
High (H)	81-120	121-180	361-540	61-90	141-210
Critical (C)	>120	>180	>540	>90	>120

Table 1 : Standard Pollution Level Classification

GIS

A **Geographic Information System (GIS)** is a system designed to capture, store, manipulate, analyse, manage, and present spatial or geographic data. GIS applications are tools that allow users to create interactive queries (user-created searches), analyse spatial information, edit data in maps, and present the results of all these operations. GIS sometimes refers to geographic information science (GIS Science), the science underlying geographic concepts, applications, and systems. Since the mid-1980s, geographic information systems have become valuable tool used to support a variety of city and regional planning functions.

GIS can refer to a number of different technologies, processes, techniques and methods. It is attached to many operations and has many applications related to engineering, planning, management, transport/logistics, insurance, telecommunications, and business. For that reason, GIS and location intelligence applications can be the foundation for many location-enabled services that rely on analysis and visualization.

CLIMATE

Amravati has a tropical wet and dry climate with hot, dry summers and mild to cool winters. Summer lasts from March to June, monsoon season from July to October and winter from November to March.

The highest and lowest temperatures ever recorded was 49.1 °C on 25 May 2013 and 5.0 °C on 9 February 1887.

TRANSPORTATION

1) ROAD: City bus service is run by the Amravati Municipal Corporation. Private auto rickshaws and cycle rickshaws are also popular. Amravati has also started a Women's Special City bus which is a first in Vidarbha region.

The Maharashtra State Road Transport Corporation (MSRTC) provides transport services for intercity and interstate travel. Many private operators also ply on the highly travelled Amravati – Pune and Amravati – Indore route. Bus services to cities like Nagpur, Yavatmal, Bhopal, Harda, Indore, Raipur, Jabalpur, Mumbai, Pune, Akola, Dharni, Nanded, Aurangabad, Jalna, Burhanpur, Parbhani, Solapur, Khandwa, Gondia, Shirdi, Hyderabad, Paratwada (Achalpur) and Kolhapur are also available.

National Highway 6 (old numbering), which runs from Hazira (Surat) to Kolkata, passes through Amravati recently new Star City Buses are launched in the city replacing the old city buses.

2) RAILWAY: Amravati has three railway stations: Amravati, New Amravati and Badnera junction, Amravati station in the heart of the city is a terminus. Railway line could not be extended beyond it. Therefore, a new station was constructed outside the city when a new railway line was laid to connect Badnera junction to Narkhed on the Nagpur-Itarsi main railway line.

3) AIRPORT : Amravati Airport, located at Bellora , 15 kilometres off NH-6 towards Akola, is operated by the Maharashtra Airport Development Company (MADC). Presently it has no commercial scheduled flights. The Nagpur Flying Club has applied to DGCA for permission to shift its flying operations to Amravati airport. It also has a helipad facility. MADC is acquiring about 400 Hectares of land for developing the airport and related facilities at an estimated cost of Rs. 2.25 billion recently Amravati Airport has been handed over to Airport Authority Of India for development.

Objectives Of Conservation Of Air Quality

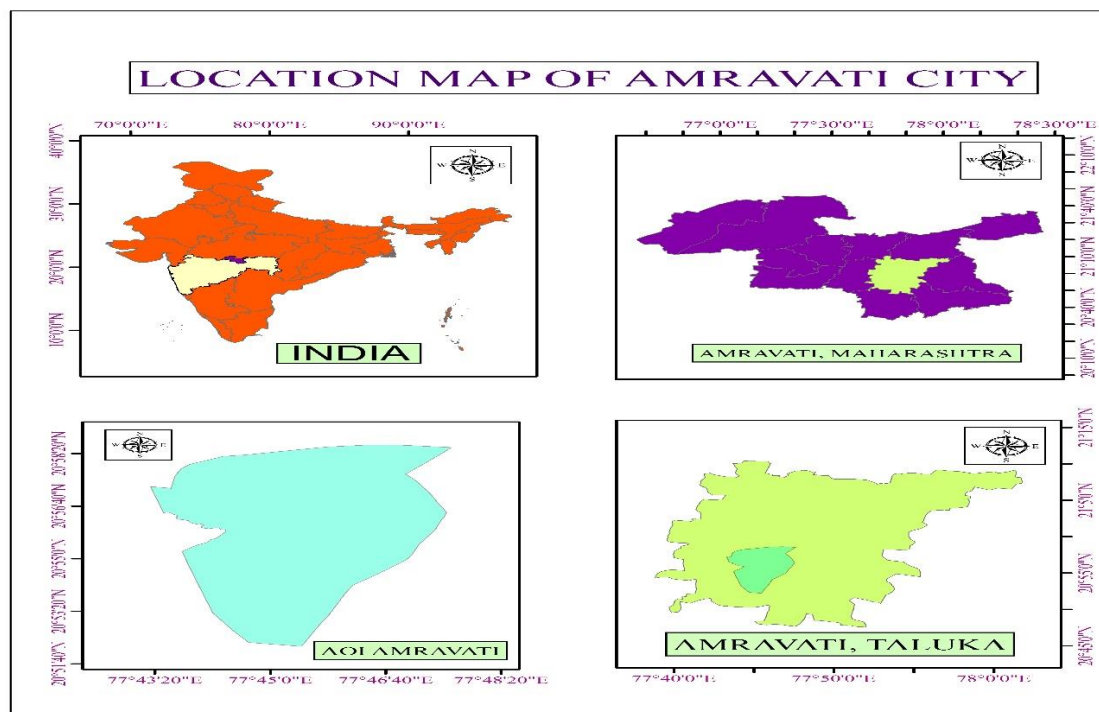
1. Protect and Enhance the quality of air resources
2. Identify major air pollutants and their sources
3. Hazards of air pollution
4. Effects seen in 5 years on environment
5. Analysis of SO_2 , NO_x and RSPM
6. Identify the diseases due to air pollution

MATERIAL AND METHODOLOGY

STUDY AREA

LOCATION

The Amravati is situated between $20^{\circ}55'33''\text{N}$ and $70^{\circ}45'53''\text{E}$. The city occupies total 183 km^2 Area. Amravati is the second largest and populous city of Vidarbha region of Maharashtra after Nagpur. It is the administrative headquarter of Amravati District. The city is located near the passes through the hills that separate the cotton-growing regions of the Purna basin to the West and the Wardha basin to the East. There are two lakes in the eastern part of the city, Chhatra Talao & Wadali Talao. Pohara & Chirodi hills are to the east of the city. The Maltekdi hill is inside the city.



Map 1 : Location Map

ARC GIS

Arc GIS is a geographical information system developed by Environmental Systems Research Institute (ESRI), for working with maps and geographic information. It is used for creating and using maps, compiling geographic data analyzing mapped information sharing and discovering geographic information, using maps and geographic information in a range of applications and managing geographic information in a database. The system provides an infrastructure for making maps and geographic information available throughout an organization, across a community and openly on the web.

ArcGIS segregates the application in different cited modules to performs different jobs viz. Arc Tool Box, Arc Map, Arc Scene, Arc Catalog etc.

IDW

Inverse distance weighting (IDW) is the most common process in GIS. IDW is a particular interpolator, hence the statistics values are well considered. The interpolation algorithm objective is to use measurements and set in point locations. IDW of interpolation methods was used to define the cell values via a set of sites sample points. IDW map included values classified as classes ranged by colors from low to high value. The estimated values are restricted to the range of the values used for interpolation. As IDW is a weighted distance average, hence, this average cannot be more than the higher value or lesser than the smaller value. GIS offers a practical and significant working environment for integrating, analyzing, and visualizing these data together with new spatial data sources (Dobesch et al. 2013).

Many studies have been carried out on air quality assessment using interpolation methods, the results of 71 methods showed that in most cases, the geostatistical processes is best than the deterministic techniques (Eslami and Ghasemi 2018).

Data Required

1. Total geographic area of city.
2. MPCB Data
3. Excel sheet data
4. Climate Information
5. Sample Location

Software Used

Arc GIS

Arc GIS is a geographical information system developed by Environmental Systems Research Institute (ESRI), for working with maps and geographic information. It is used for creating and using maps, compiling geographic data analyzing mapped information sharing and discovering geographic information, using maps and geographic information in a range of applications and managing geographic information in a database. The system provides an infrastructure for making maps and geographic information available throughout an organization, across a community and openly on the web.

ArcGIS segregates the application in different cited modules to perform different jobs using Arc Tool Box, Arc Map, Arc Scene, Arc Catalog etc.

1. ARCGIS10.3
2. Google Earth Explorer
3. Microsoft Office
4. Microsoft Excel
- 5.

Data Collection

The Data is collected from the various sampling stations of Amravati and it is mainly gathered and downloaded from the MPCB website of Maharashtra.

METHODS

1. Boundary Extraction
2. CSV format in Microsoft Excel Sheets
3. Map making in ARC GIS.

PROCESS

I. Boundary Extraction

Open Google Earth Pro → Draw the polygon over the Amravati City → Save it in a folder → Open the ARC GIS → arc toolbox → conversion tool → To kml → layer to kml. Boundary (Shape file) of Amravati City.

II. Excel Sheets

Open Microsoft Excel → Blank Workbook → Add data downloaded from MPCB site → Make table of the readings → table in the form of NO_x, SO₂, RSPM etc. → Save it in two formats → 1) Excel Workbook, 2) CSV (comma delimited) → save it in two forms.

III. MAP MAKING (ARC GIS)

Open ArcGIS(Arc Map) → Open CatLog → Open the folder where the CSV file saved → right click on the file → create feature class → From XY Table → add the data in fields → OK. → Shape file of the particular Excel sheet is ready.

Drag the gdb file of Amravati city from the folder → Drag the Excel sheet file on it. → Open Arc tool box → Spatial Analysis tool → Interpolation → IDW → fill the data → Environments → Processing Extent → Extent (same as layer polygon) → Mask → Excel sheet → OK → OK.

Table of Content → Right click on the file → properties → Symbology → classes 12 → apply → OK.

LAYOUT

Layout View → File → Page and Print Setup → Size A4 → OK → Insert → North arrow, Title, scale bar, legend (Adjust it into neat line) → Insert → dynamic text → Coordinate system (Adjust it into neat line) → Apply Neat line → Insert → Neat line → Border (0.5 or 1). Adjust the map into neat line. → Final map is ready.

EXPORT MAP

1. For .mxd format

File → Save as → Give location of folder → OK

2. For .jpg

File → Export map → Give location of folder → Save as type → JPEG → resolution → more than 500 → OK

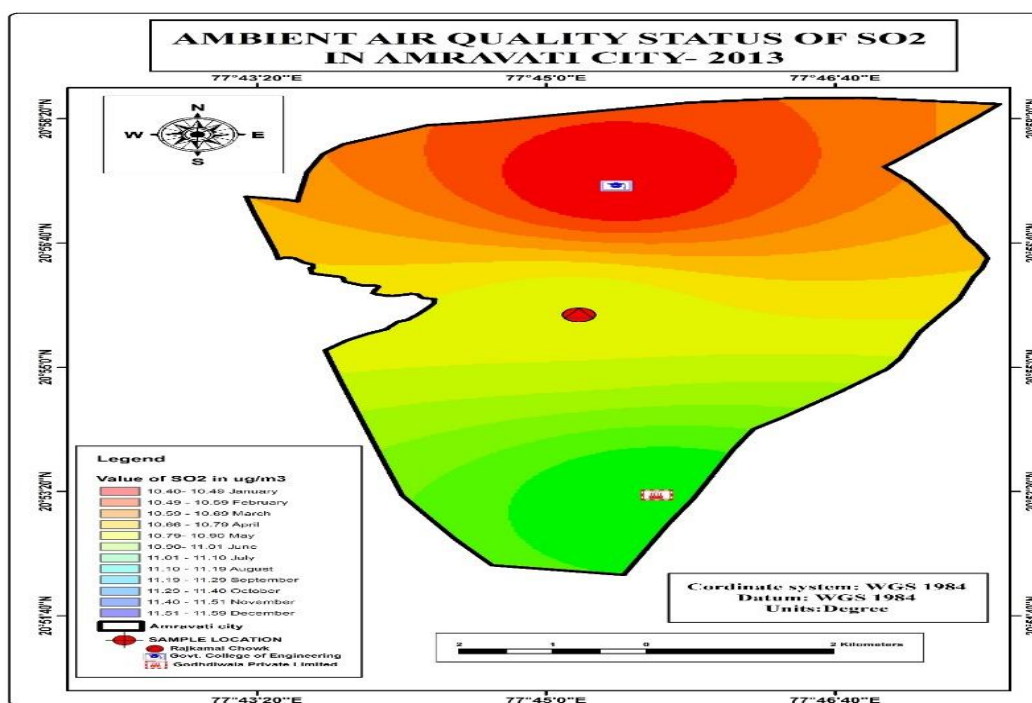
3. For PDF

File → Export map → Give location of folder → Save as type → PDF → OK.

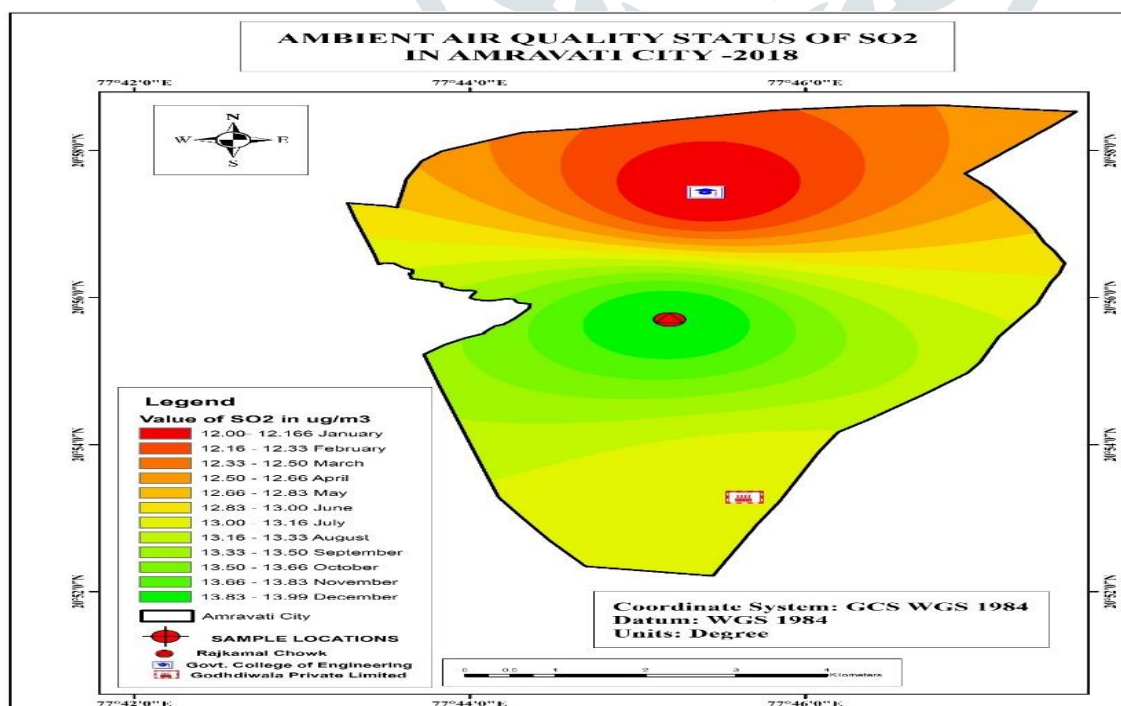
THEMATIC MAPS

- **LOCATION MAP:** It referred to as locator and is typically a simple map used to show the location of a particular geographic area. Location map provides a reference to map users when the spatial location of the detailed map might be hard to determine.
- **AIR POLLUTION MAPS:** this maps are made in Arc GIS. It typically provides the information of the pollutants present in the air. The main pollutants studied in this project are SO₂, NO_x, RSPM of the study area

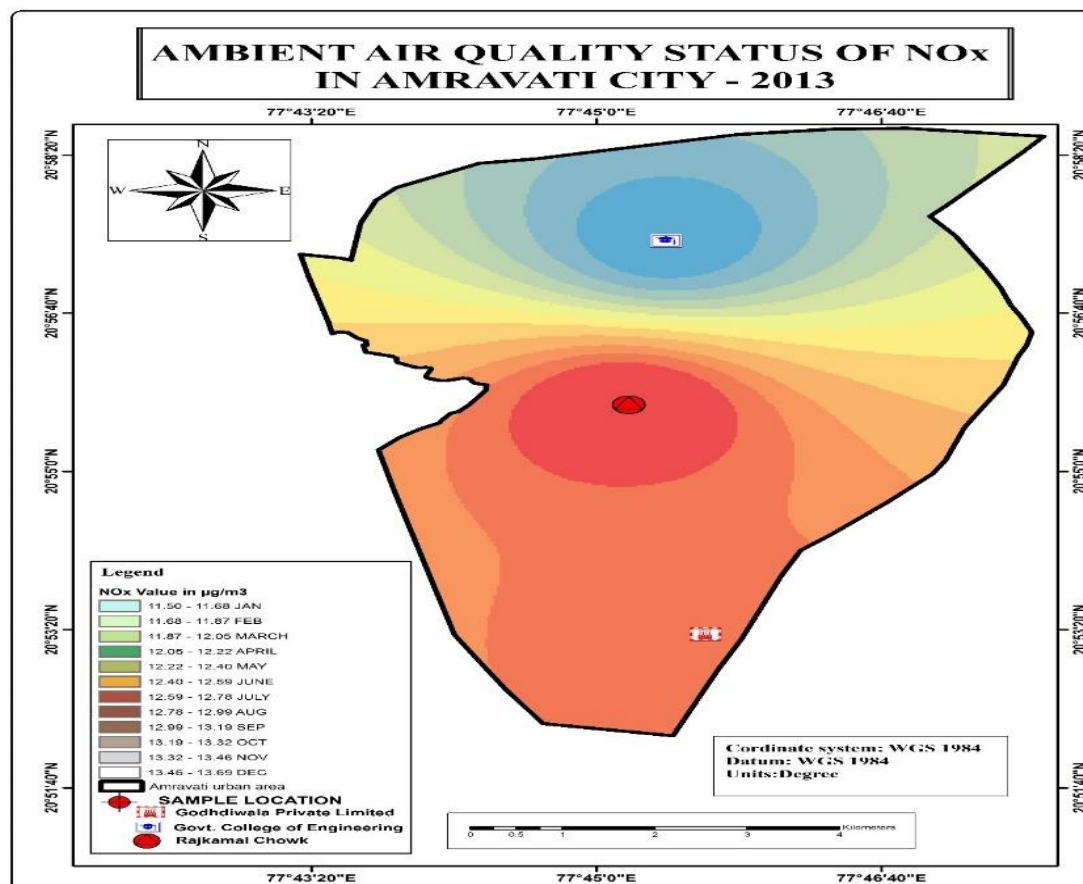
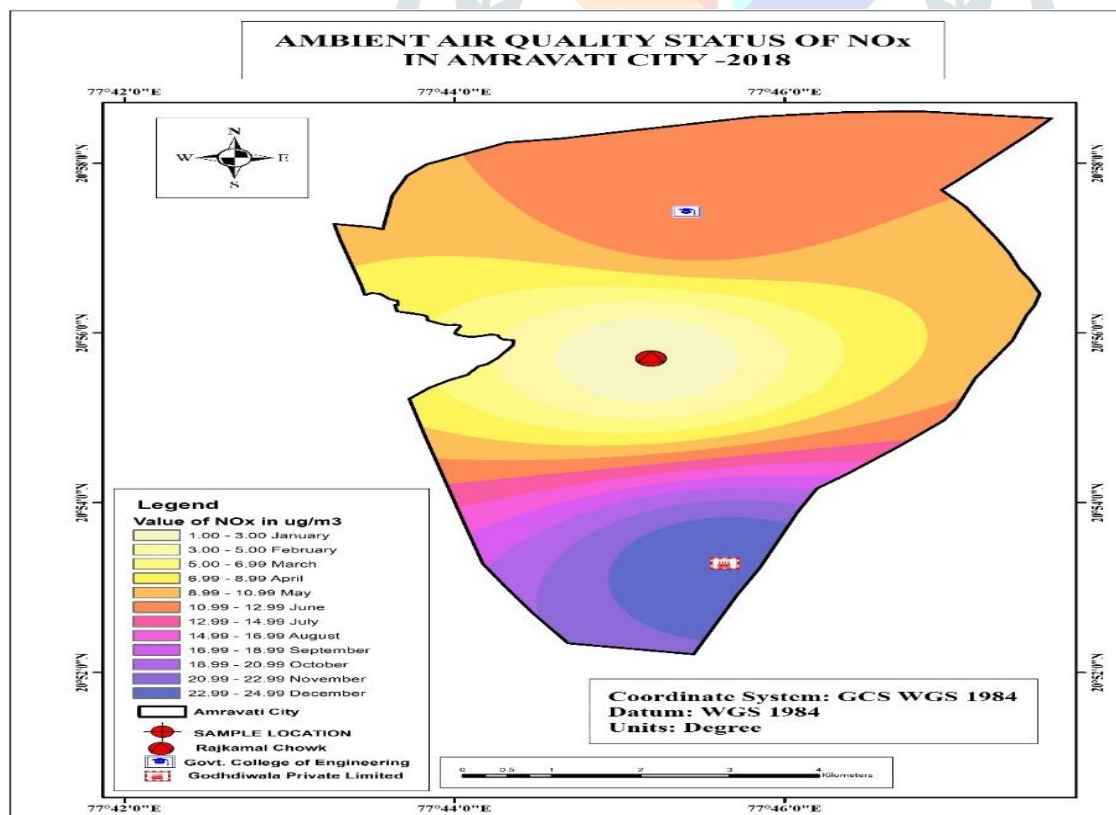
Result And Discussion

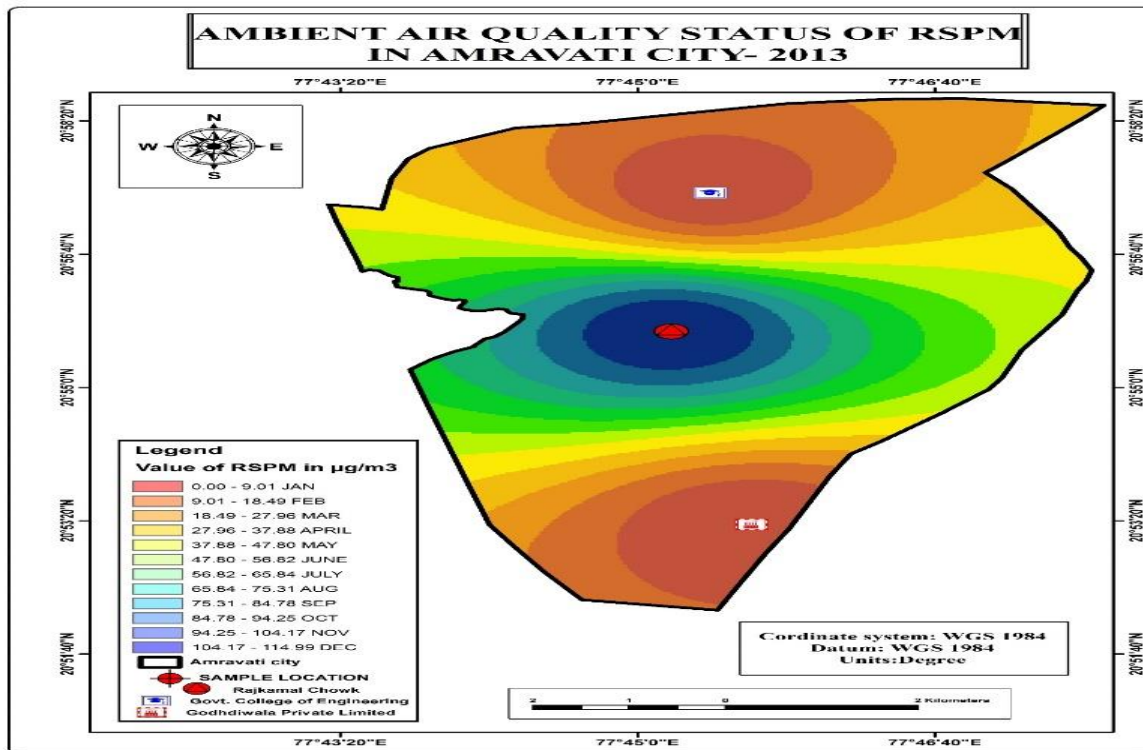


Map 2 : SO_x Map of Amravati City-2013

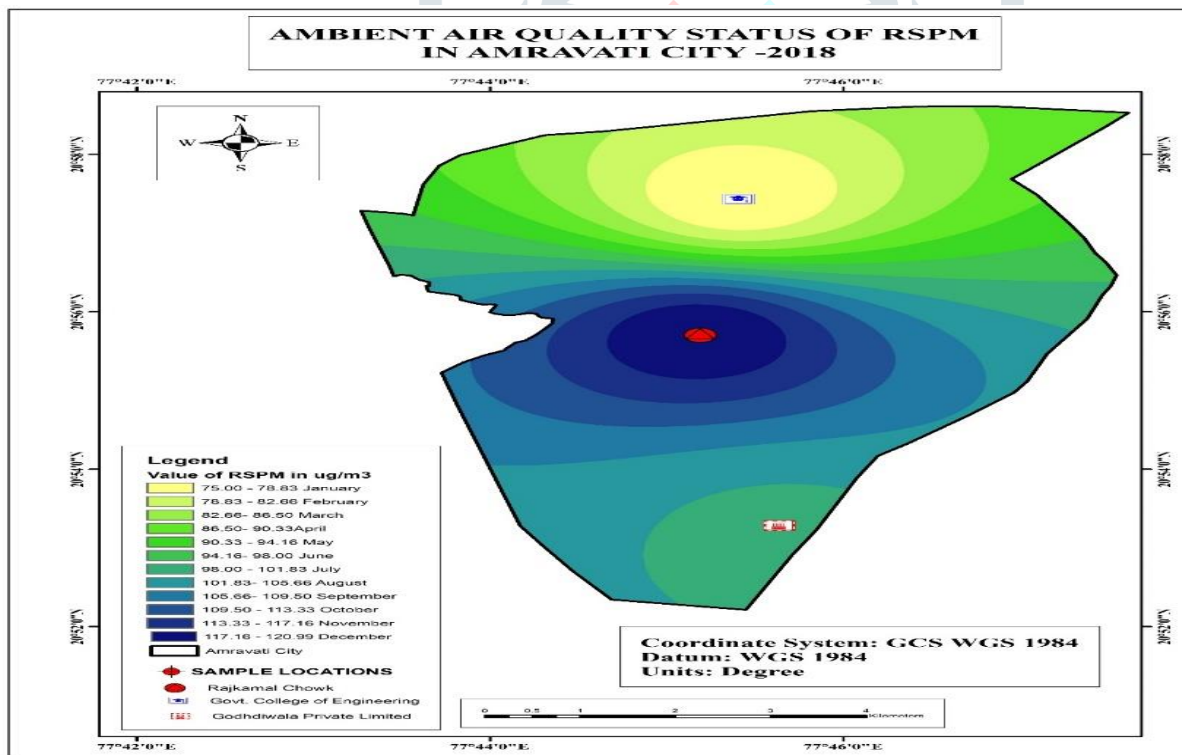


Map 3 : SO_x Map of Amravati City-2018

Map 4 : NO_x Map of Amravati City-2013Map 5 : NO_x Map of Amravati City-2018



Map 6 : RSPM Map of Amravati City-2013



Map 7 : RSPM Map of Amravati City-2018

By using Geographic Information System(GIS) we used the ARCGIS10.3, Google Earth Explorer, Microsoft Office, Microsoft Excel, in this softwares we do Interpolation , Inverse Distance Weightage(IDW) methodology which useful for to analyze and visualize the various parameters of Air Quality to prepared Thematic Maps shows that.

➤ As Map No 2&3 Shows the Air Quality Status of SO_x which Compared from Year 2013 -2018. The 2018 Air Quality of SO_x are increased as compared to 2013, but they do not exceed the Standard level which show in Table No.1, so that Amravati City not in dangerous level of Air Quality of SO_x .

- As Map No 4 & 5 Shows the Air Quality Status of NO_x which Compared from Year 2013 -2018. The 2018 Air Quality of NO_x are increased as compared to 2013, but they do not exceed the Standard level which show in Table No.1, so that Amravati City not in dangerous level of Air Quality of NO_x .
- As Map No 4 & 5 Shows the Air Quality Status of RSPM_x which Compared from Year 2013 -2018. The 2018 Air Quality of RSPM_x are increased as compared to 2013, and they exceed the Standard level which show in Table No.1, so that The Amravati City will be in danger if the polluting sources are not controlled.

CONCLUSION

The Amravati City will be in danger if the polluting sources are not controlled. The RSPM level in increased rapidly and is dangerous in the year 2018 than in the year 2013. To control the pollution level in city various measures are suggested to controlled from the sample locations such as

- Use Public mode transport
 - Conserve Energy
 - Understand the concept of Reduce, Reuse and Recycle
 - Emphasis on clean energy resources
 - Use energy efficient devices
 - To install pollution control devices
 - Development of green belt area
 - Vehicle pollution is very high due to increase in vehicles use
 - Use clean alternative fuels like CNG , LPG & Bio fuels
 - Augmentation in public transport system
 - As the pollution level is increased very high in last 5 years it will also increase tremendously in future to control it the law which are in favor of environment must be followed strictly
 - Plant more trees
 - Plant following trees in more number because it will help to clean air indoor and in environment also ,
1. **Areca Palm (*Chrysalidocarpus lutescens*)**
 2. **Dwarf Date Palm (*Phoenix roebelenii*)**
 3. **Boston Fern (*Nephrolepis exaltata* "Bostoniensis")**
 4. **Gerbera Daisy (*Gerbera jamesonii*)**
 5. **Heart-Leaf Philodendron (*Philodendron Oxycardium*)**
 6. **Spider Plant (*Chlorophytum comosum*)**
 7. **Aloe Vera (*Aloe barbadensis*)**
 8. **Ocimum tenuiflorum**

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